Dept. of Chemistry, Sohage,
Fac. of Scince Assiut University
Head of Dept. Prof. Dr. F. EL-Sheikh

# SELECTED MINERALS IN MEAT, LIVER, FAT AND KIDNEY IN BUFFALOE AND CATTLE IN ASSIUT, EGYPT.

(With 4 Tables & 5 Fig.)

By

NAGWA M. EL-SAWI; M. ABDEL-NASSER*;
E. ABU-AMRA** and A. SH. SEDDEK*

(Received at 25/12/1993)

# تحديد بعض المعادن فى لحوم ، كبد ، دهون وكلى الجاموس والأبقار فى محافظة أسيوط

نجوى الصاوى ، محمود عبد الناصر ، الصبرى أبو عمره
عبد اللطيف شاكر

تم فى هذا البحث قياس البوتاسيوم والصوديوم والنحاس والكادميوم والباريوم والمنجنيز والسترانشيوم المتبقيه فى ٣٨ عينه من اللحوم والدهون والكبد والكلى المأخوذه من الجاموس والأبقار المذبوحه فى محافظة أسيوط خلال صيف ١٩٨٩ - ١٩٩٠م .

وجد الباحثون أن أعلى تركيز للبوتاسيوم كان فى عينات الكبد حيث بلغ ٥ ر ٢١ ، ٦ ر ٢١ ميكروجرام / جرام من الوزن فى الجاموس والأبقار على التوالى. كان تركيز الصوديوم عاليًا فى كلى الحيوانات حيث بلغ ٩ ر ١٣ ، ٦ ر ١٤ ميكروجرام / جرام فى الجاموس والأبقار على التوالى. أظهرت النتائج وجود النحاس والكادميوم والنيكل بنسب متفاوته فى جميع العينات المأخوذه. أظهر تحليل العينات بحثًا عن المنجنيز وجوده بنسب أعلى فى لحوم وكبد وكلى الجاموس عنها فى الأعضاء الخاصه بالأبقار .

أظهر البحث وجود الباريوم والسترنشيوم بكميات متفاوته فى العينات التى تم فحصها .

---

*: Dept. of Forensic Medicine & Toxicology, Fac. Vet. Med., Assiut University.
**: Dept. of Zoology, Sohage, Faculty of Science, Assiut University.

## SUMMARY

Potassium, sodium, copper, cadmium, barium, nickel, manganese and strontium residues were determined in thirty eight samples of meat, fat, liver and kidney of both cattle and buffaloe slaughtered at Assiut Governorate during summer 1989-1990. The highest concentration of potassium found to be 21.50 and 21.60 μg/g and 21.60 μg/g dry weight in liver tissue of buffaloe and cattle respectively. Sodium concentrations were high in kidney tissues which reached 13.90 and 14.60 μg/g dry weight in buffaloe and cattle respectively. Copper levels in the livers of buffaloe and cattle were 0.27 and 0.30 μg/g tissue respectively. Cadmium shows the same pattern of distribution in fat, meat, liver and kidneys of both cattle and buffaloe. The highest contents of Nickel were found in fat, followed by kidney, liver and meat in declining sequence. Buffaloe meat, liver and kidneys show higher concentrations of Manganese than that of cattle. Barium and strontium are distributed more evenly among the various tissues of both buffaloe and cattle.

## INTRODUCTION

Since the industrial revolution, the efforts of removing man made pollutants from the natural environment have been unable to keep pace with the increasing amont of waste materials and growth of population that further aggravates that situation. This has often resulted in the transformation of lakes, rivers and coastal waters into sewage depots where the natural biological balance is severely upset and in some cases totally disrupted.

The toxicologic importance of most metals and metalic compounds, as well as their major contribution to environmental pollution through industrial discharges and agricultural runoff, have been well do-cumented *(ROY et al., 1992)*.

The concentration of trace metals in animal tissues were determined by many researchers. *AGTHE and DICKEL (1980)* investigated cadmium content in kidneys of cattle slaughtered in sanitary slaughter houses. *RENUMERTHLY et al. (1980)* recorded higher cadmium contents in kidney and liver of healthy cattle from the mid western united states.

Cadmium enters the biosphere through its increasing in electroplating in plastics as stabilizer, in paints as pigments, in cadmium batteries and as a contaminant in phosphate fertilizers and sewage sludges. Superphosphate fertilizer contains cadmium at about the same levels present in the original rock. *RUICK and SCHMIDT (1982)* determined cadmium in livers and kidneys of animals of the industrialized parts of the German Democratic Republic. *RUXTROF* et al. (1983) determined cadmium, copper and zinc contents in kidneys of bulls and cows. *VOS* et al. *(1991)* investigated Arsenic, cadmium, lead and mercury in meat, livers and kidneys of sheep slaughtered in Netherlands.

The contents of trace elements in the tissue may reflect the nutritional status of the animals. *LAMPHESE* et al. *(1984)* recorded that cadmium content of liver, kidney cortex and muscles of calves were markedly increased by feeding of cadmium.

According to *ZIRSCHKY and REED (1988)*, contamination substances, contained in industrial waste discharged into the environment, affects animals and plants in adverse way. Heavy metals, such as cadmium, mercury and lead, metal organic compounds such as methyl mercury are considered to be the offending substances, in the effluents *(HATANO and HATANO, 1992)*.

According to *IKARASHI* et al. *(1992)*, Nickel and chromium hypersensitivity are a common form of contact dermatits in the human. They added that the incidence of metal allergy, especielly nickel allergy is steadily increasing in recent years.

One factor that results in increased scientific and public awareness about the effects of an environmental contaminant is its persistence. Since the heavy metals are elements, they can not be degraded once released.

In the present survey the question is being discussed whether cattle and buffaloe are an appropriate detectors for environmental comtamination with the heavy metals. This is done by evaluation of barium, potassium, Sodium, Copper, cadmium, nickel and Manganese concentrations in meat, fat, livers and kidneys of Slaughtered buffaloes and cattles at Assiut Province.

## MATERIALS and METHODS

this study was performed on thirty-eight samples of both cattle and buffaloe aged from 21-24 months slaughtered at Assiut region during the summer 1989-1990 and collected from

Sanabu, Mir, El-Qusiya, Manfalut, Beny Muhammediyat, Abnub, Assiut, Abutig and Sidfa as shown in the map of collection sites Fig. (5). Muscle, Fat, Liver and Kidney samples were collected and kept at-20°C until analysis.

Tissue levels of trace elements were estimated by perkin Elemer model 2380 Atomic Absorption spectrophotometric according to *FAHMY (1971) and GAJAN and LARRY (1972).* One gram of dried sample to be analyzed for trace elements was taken in clean dry kjeldahl flask of 250-300 ml Capacity, 5 ml of analar sulphuric acid and 5 ml analar concentrated nitric acid were added. The flasks were heated gently over a low flame of a minor-burner until clear fumes of nitric and sulphuric acids appear, when the flame was turned off and the flasks allowed to cool. On reheating the flasks brown liquid formed in the flasks gradually disapeared. Complete digestion is indicated by colourlessness of the liquid. Stronger heating was continued for some time to drive off most of the nitric acid in the flask. The digested material was diluted volumetrically to 100 ml with glass deionized water and then filtered in measuring flask and adjusted to 100 ml. Measuring of metals concentrations was done with atomic absorption spectrophotometry.

## RESULTS

The results obtained in this investigation are summarized in tables 1, 2, 3 and 4. Since the trace element concentrations often did not show a normal distribution, the mean values are given with the upper most and lower most values.

## DISCUSSION

In nonindustrial situations, the major expsure of humans to toxic elements occurs principally through their normal food supply. Exceptions almost always results from environmental concentration or the inappropriate use of seeds that have been treated with heavy metal fungicide for animal or human food *(SANDSTEAD, 1977).*

A major toxicological issüe today is the possibility of unusual toxicity due to interaction of toxic chemicals upon environmental or occupational exposures to two or more chemicals, at ordinarily harmless levels.

Our results of cadmium concentrations in livers and kidneys of cattle were in agreement with that registered by *RENUMARTHY* et al. *(1980).* The recorded levels seems to be below those generally considered toxic. The significance of low concentrations of toxic metals in food is unknown, but observations in experimental models have suggested interference with the metabolism of certain essential elements and other nutrients. Therefore, the presence of toxic metals at low levels in human food might have biological implications if the essential element or nutrient with which they interfere are present in marginal amounts.

There are wide variations between our results in copper, Manganese and Nickel concentrations and that registered in many papers, *SOLLY* et al. *(1981)* and *YOUSSEF* et al. *(1988)*. These variations could be contributed to the degree of pollution, levels of metals in the soil and the live elapsed for the animal in this region. Metal residues in the examined tissues showed little variation, but there were a few exceptions. The cadmium concentrations varied considerably, especially those in livers and kidneys. This is probably mainly attributed to difference in exposure as seen in Fig. 1, 2, 3 and 4. No clear trends were observed in tissue element levels during the reported period.

According to *THORNTON (1983)*, High concentrations of some metals in the environment may endanger the health of plants and animals and may also affect the suitability of food stuffs and water supplies for human consumption. He added that metals may be present as pollutants from industry or originate from the weathering products of natural metal-rich-bedrocks. It is possible that the differences in metal residues between cattle and buffaloe reflect local differences in contamination of foods given to the animals.

According to *EARLY* et al. *(1992)*, Cadmium is an environmental Contaminant which is known to induce toxic effects after long and short term exposure. Increasing concentrations of cadmium in the environment have drawn much alteration due to its possible delecterious effect. He added that there have been reports indicate that cadmium treatment results in specific mitochondrial alterations.

High concentrations of manganese in this study could be discussed in relation to *HARPER'S (1991)*, who cited that the kidney and liver are the chief storage organs for manganese.

Copper was detected in all samples analyzed for heavy metals. Average residue levels showed little variations except in case of liver copper which reached 0.27 µg/g in buffaloe and 0.30 µg/g in cattle. Copper tends to be accumulated in the liver.

It must be remembered that the amount of various elements are necessary to the proper nutrition of the human and animal body. Enzyme systems require the presence of zinc, calcium, sodium, copper, cobalt, potassium, molybdenum, manganese and selenium and some of these elements take part in other metabolic activities involving the nervous and other systems. Execess amounts of copper in food has, however, given rise to outbreaks of poisoning. Strontium was registered in all analyzed samples of both cattle and buffaloe as well as barium which showed its highest levels in meat and fat of both cattle and buffaloe.

Finally we can concluded that the prefered accumulation targets for heavy metal, are liver and kidneys. *HAPKE and GRAHWIT (1987)* wrote the same result. Muscles as well as fat tissues contain much lower levels in most cases. Levels of heavy metals in buffaloe tissues are significantly different from that of cattle, and could be attributed to habitat and species differences.

## REFERENCES

*Agthe, O. and Dickel, S. (1980):* Uber den Blei-and cadmium gehalth in Rindernieren Abhangigkeit von zwei verschiedenen standorten sowie vom lbensalter. Arch. Lebensmittelhyg. 31: 169.

*Early, J.T.; Nonavinaker, V.K. and Weaver, A. (1992):* Effect of cadmium and/or seleniun on liver mitochondria and rough endoplasmic reticulum in the rat. Toxicology letters, 62: 73-83.

*Fahmy, F. (1971):* Studies on factors affecting copper level in Egyptian sheep. Thesis, Ph.D., Vet. Med., Cairo Univ.

*Gajan, R.J. and Larry, D. (1972):* Determination of lead in fish by atomic absorption spectrophotometry and by polarography. 1- Development of method. J. Assoc. Off. Anal. Chem. 55: 127.

*Hapke, H.J. and Grahwit, G. (1987):* Residues of veterinary drugs, feed additives and Environmental chemicals. World Anual Sciences, El Seveier Science publishers, chapter 7, pp. 219-244.

*Harper, H.A. (1991):* Review of physiological chemistry, 21th ed., Lang medical publications.

*Hatano, Y. and Hatano, A. (1992):* Effects of sea water pollution on chicken embryos, Toxicology Letters, 62: 1-7.

*Ikarashi, Y.; Tsuchiya, T. and Nakamura, A. (1992):* Detection of contact sensitivity of metal salts using the murine local lymph node assay, Toxicology letters, 62: 53-61.

*Lamphese, D.N.; Dorn, C.R.; Reddy, C.S. and Meyer, A.W. (1984):* Reduced cadmium body burden in cadmium exposed calves fed supplemental zinc. Environ. Res. 33: 119.

*Renumarthly, L.; Oehme, F.W. and Hayes, R.H. (1980):* Lead, Cadmium, and mercury tissues residues in healthy swine, cattle, dogs, and horses from the midwestern united states. Arch. Environ. Contam. Toxical. 9: 193.

*Ruick, G. and Schmidt, M. (1982):* Zur Kontamination tierischer leebensmittel mit cadmium. Nahrung, 26: 733-735.

*Ruxtrof, U.P.; Hegersweiler, P. and Hermann, A. (1983):* Gehalt an schwermetallen in tierischen lebensmitteln: Nieren und Meeresfruchte, Mitt-Gebiete Lebensm. Hyg. 74: 93.

*Roy, A.K.; Dhir, H. and Sharma, A. (1992):* Modification of metal induced micronuclei formation in mouse bone marrow erythrocytes by phyllanthus fruit extract and ascorbic acid. Toxicology letters, 62: 9-17.

*Sandstead, H.H. (1977):* Nutrient interaction with toxic elements in toxicology of trace elements. Hemisphere publisher Co. London, Chapter 8, pp. 241-256.

*Solly, S.R.B.; Revfeim, K.J.A. and Finch, G.D. (1981):* Concentrations of cadmium, copper, selenium, Zinc and lead in tissues of Newzealand cattle, Pigs, and sheeps. Newzealand J. Sci., 24: 81.

*Thornton, I. (1983):* Applied Environmental Geochemistry. Edited by Iain Thornton. Academic Press Geology Series. 1st Edition. pp. 64-73.

*Vos, G.; Lammers, H. and Van Delft, W. (1991):* Arsenic, Cadmium, Lead, and mercury in meat, livers, and kidneys of sheep slaughtered in Netherlands. Z. Lebensm. unters. Forsch. 187(1): 1-7.

*Youssef, H.; Hassan, H.A. and Galal, A.F. (1988):* Cadmium, Copper and zinc in tissues of animals slaughtered in upper Egypt. Deutsche Veterinarmedizinische Gesellschaft e.v. 313-319.

*Zirschky, J. and Reed, S.C. (1988):* The use of duck weed for waste water treatment, J. Water pollut. Control Fed., 60: 1253-1256.

Table (1):Potassium and Sodium concentrations in meat, fat, liver and Kidney of buffaloe and cattle (n = 38) µg/g dry weight

| animal | Tissue | Potassium | | Sodium | |
|---|---|---|---|---|---|
| | | Range | Mean ± S.D. | Range | Mean ± S.D |
| buffaloe | Meat | 18.94 - 22.29 | *** 20.46 ± 1.04 | 4.96 - 6.90 | *** 5.72 ± 0.48 |
| | Fat | 4.54 - 6.06 | *** 5.14 ± 0.46 | 2.50 - 5.32 | *** 3.92 ± 0.92 |
| | liver | 19.79 - 23.59 | N.S. 21.50 ± 1.01 | 5.59 _ 8.92 | *** 7.79 ± 0.77 |
| | Kidney | 17.21 - 22.32 | N.S. 21.56 ± 1.06 | 12.99 _ 15.21 | * 13.93 ± 0.65 |
| Cattle | Meat | 21.69 - 24.86 | 23.40 ± 0.83 | 7.50 - 9.00 | 8.37 ± 0.55 |
| | Fat | 6.99 - 11.45 | 8.77 ± 0.96 | 3.98 - 6.92 | 5.62 ± 0.71 |
| | liver | 19.56 - 23.98 | 21.56 ± 1.06 | 10.82 - 12.77 | 11.77 ± 0.50 |
| | Kidney | 18.81 - 21.92 | 20.74 ± 0.78 | 12.99 - 15.99 | 14.60 ± 0.82 |

* Significant $P \leq 0.05$

** Significant $P \leq 0.01$

*** Significant $P \leq 0.001$

The correlation values were between buffaloes and cattle in all tissues.

Table (2) : Cadmium and Copper concentrations in meat, fat, liver and kidney of buffaloe and cattle (n = 38) µg/g. dry wight.

| animal | Tissue | Cadmium Range | Cadmium Mean ± S.D. | Copper Range | Copper Mean ± S.D. |
|---|---|---|---|---|---|
| buffaloe | Meat | 0.1440-0.1990 | 0.1670±0.0179 | 0.0550-0.0790 | 0.0712±0.0058 *** |
| | Fat | 0.0590-0.2900 | 0.1697±0.0613 | 0.0350-0.0621 | 0.0457±0.0079 * |
| | liver | 0.1050-0.1910 | 0.1501±0.0257 | 0.2131-0.2931 | 0.2688±0.0212 * |
| | Kidney | 0.1400-0.1930 | 0.1691±0.0146 ** | 0.0132-0.1910 | 0.1012±0.0456 |
| Cattle | Meat | 0.1010-0.2910 | 0.1882±0.0402 | 0.0400-0.0600 | 0.0470±0.0042 |
| | Fat | 0.1400-0.3100 | 0.1817±0.0397 | 0.0250-0.0421 | 0.0321±0.0058 |
| | liver | 0.1140-0.1950 | 0.1509±0.0303 | 0.2420-0.3510 | 0.3002±0.0330 |
| | Kidney | 0.1320-0.1820 | 0.1478±0.0146 | 0.0420-0.1920 | 0.1147±0.0469 |

* Significant $P \le 0.05$
** Significant $P \le 0.01$
*** Significant $P \le 0.001$

Table (3): Manganese and nickel concentration in meat, fat, liver, and Kidney of buffaloe and cattle (n = 38) µg/g dry weight.

| animal | Tissue | Manganese | | Nickel | |
|---|---|---|---|---|---|
| | | Range | Mean ± S.D. | Range | Mean ± S.D. |
| buffaloe | Meat | 0.0850-0.1030 | 0.0940±0.0090 *** | 0.0340-0.0930 | 0.0601±0.0144 |
| | Fat | 0.0210-0.0510 | 0.0342±0.0071 | 0.1600-0.3610 | 0.2716±0.0529 |
| | liver | 0.0610-0.090 | 0.0751±0.0149 | 0.0784-0.2744 | 0.1764±0.0980 |
| | Kidney | 0.0510-0.0930 | 0.0721±0.0130 ** | 0.1350-0.1896 | 0.1713±0.0183 |
| Cattle | Meat | 0.0030-0.1560 | 0.0511±0.0301 | 0.0110-0.0910 | 0.0690±0.0173 |
| | Fat | 0.0150-0.0400 | 0.0303±0.0073 | 0.0321-0.9000 | 0.1946±0.1756 |
| | liver | 0.0491-0.0831 | 0.0681±0.0123 | 0.1310-0.1960 | 0.1699±0.0224 |
| | Kidney | 0.0270-0.0530 | 0.0405±0.0064 | 0.1390-0.1840 | 0.1608±0.0127 |

* Significant $P \leq 0.05$
** Significant $P \leq 0.01$
*** Significant $P \leq 0.001$

Table(4): Strontium and barium concentrations in meat, Fat, liver and Kidney of buffaloe and cattle (n = 38) µg/g dry weight.

| animal | Tissue | Strontium | | Barium | |
|---|---|---|---|---|---|
| | | Range | Mean ± S.D. | Range | Mean ± S.D. |
| buffaloe | Meat | 0.0100-0.1700 | 0.1079±0.0452 | 1.2500-1.7500 | 1.3758±0.1096 * |
| | Fat | 0.1090-0.1920 | 0.1444±0.0156 | 1.0900-1.9510 | 1.5169±0.1494 * |
| | liver | 0.0500-0.4400 | 0.1493±0.0787 | 0.5410-0.7810 | 0.6532±0.0717 * |
| | Kidney | 0.0050-0.1510 | 0.0629±0.0402 | 0.4920-0.8510 | 0.5999±0.0736 ** |
| Cattle | Meat | 0.0500-0.3100 | 0.1272±0.0571 | 1.1500-1.9200 | 1.4779±0.1925 |
| | Fat | 0.0410-0.1936 | 0.1468±0.0674 | 1.0900-1.9900 | 1.8205±0.2013 |
| | liver | 0.0700-0.1930 | 0.1476±0.0386 | 0.6690-0.8700 | 0.7801±0.0424 |
| | Kidney | 0.0100-0.1600 | 0.0642±0.0535 | 0.7820-0.8600 | 0.8210±0.0390 |

* Significant $P \leq 0.05$
** Significant $P \leq 0.01$
*** Significant $P \leq 0.001$

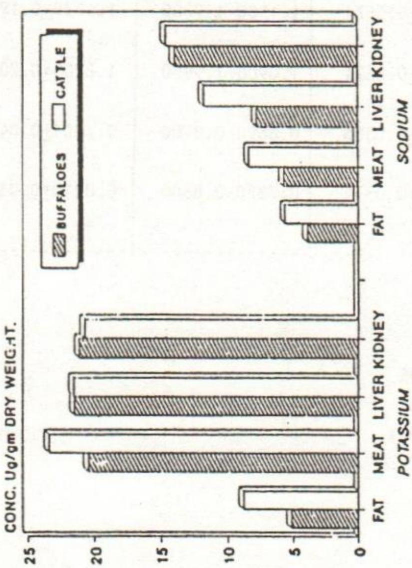


Fig. 1.

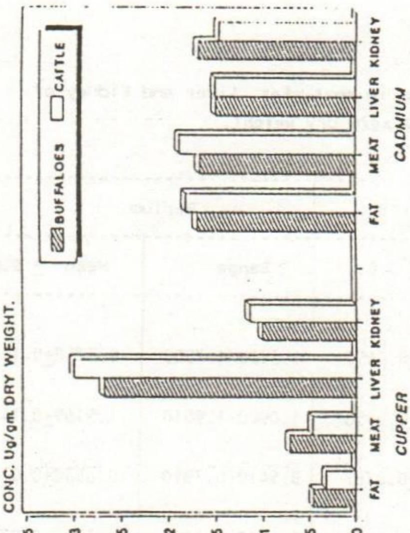


Fig.2.

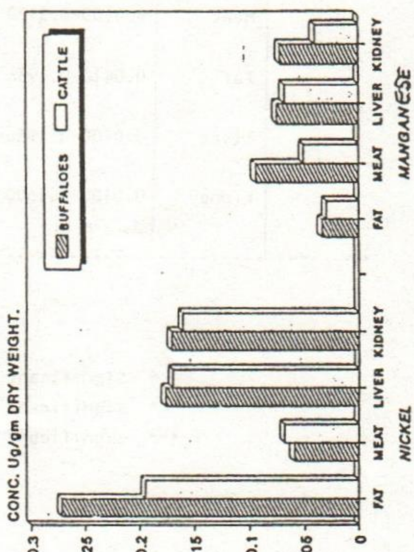


Fig.3.

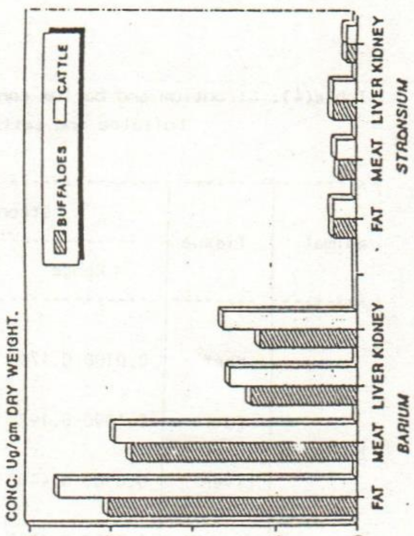


Fig.4.

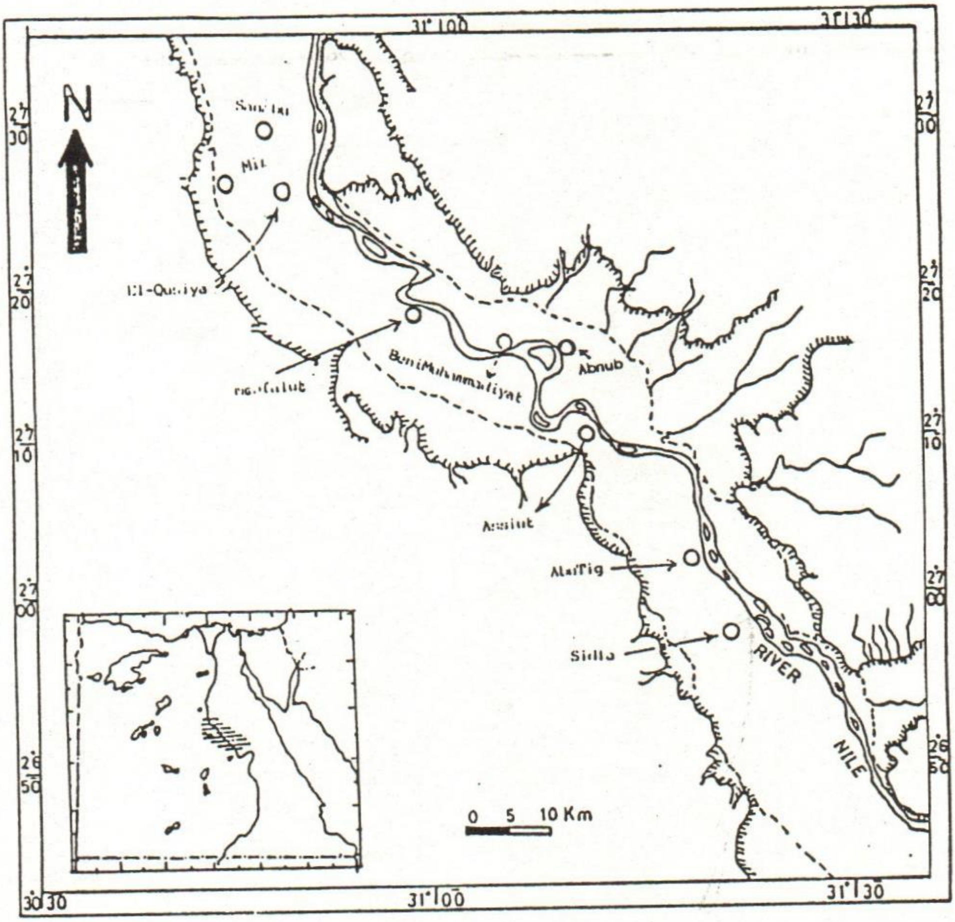


Fig.5. Location map of the studied areas